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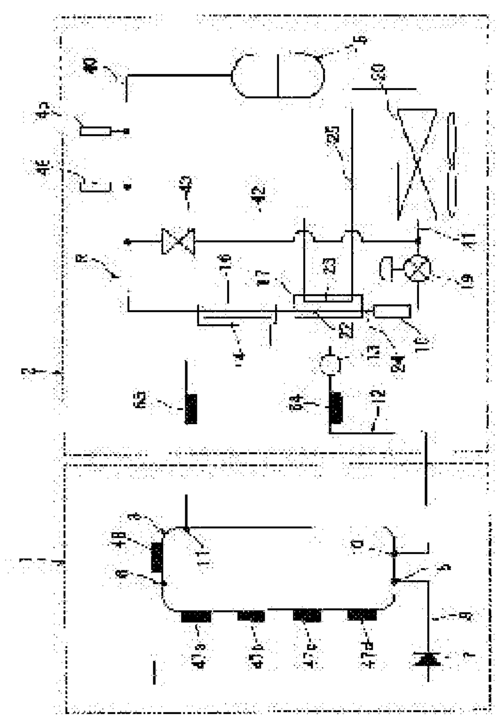
(54) REFRIGERANT CIRCUIT

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a refrigerant circuit capable of maintaining an adequate refrigerating cycle in various situations of operation.

SOLUTION: The circuit is equipped with a compressor 15, a condenser 16, a receiver 18, an expansion valve 19 and an evaporator 20. A supercritical refrigerant used in a supercritical condition is used as the refrigerant in the circuit. A cooling part 17 for cooling the refrigerant flowing out from the condenser 16 is provided on the upstream side of the receiver 18. A part of the evaporator 20 is made the cooling part 17 by making it function as an air heat exchanger. The cooling part 17 conducts heat exchange with the refrigerant on the outlet side of the evaporator 20.



DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the refrigerant circuit used, for example for the heat source unit of a heat pump type hot water supply apparatus.
[0002]
[Description of the Prior Art]A heat pump type hot water supply apparatus is provided with the tank unit 71 which has the hot water reservoir tank 70, and the heat source unit 73 which has the refrigerant circuit 72 as generally shown in drawing 27. The refrigerant circuit 72 is provided with the compressor 74, the condenser (hydrothermal exchanger) 75, the receiver 76, the expansion valve 77, and the evaporator 78. And the tank unit 71 is provided with the above-mentioned hot water reservoir tank 70 and the circuit 79, and the pump 80 and the heat exchanging path 81 are interposed in the circuit 79. In this case, the heat exchanging path 81 comprises the hydrothermal exchanger 75.
[0003]Therefore, if the compressor 74 is made to drive and the pump 80 is made to drive (operation), stored water (warm water) will flow into the circuit 79 out of the sluice gate provided in the pars basilaris ossis occipitalis of the hot water reservoir tank 70, and this will circulate the heat exchanging path 81. Then, this warm water is heated by the condenser (hydrothermal exchanger) 75 (**********), and returns to the upper part of the hot water reservoir tank 70 from a hot water supply port. By this, hot warm water is collected to the hot water reservoir tank 70.
[0004]In the former, although a refrigerant like dichlorodifluoromethane (R-12) or chlorodifluoromethane (R-22) has been used as a refrigerant of the above-mentioned refrigerant circuit, A substitute refrigerant like 1,1,1,2-tetrafluoro ethane (R-134a) is used from problems, such as depletion of an ozone layer, and environmental pollution. However, also in this R-134a, since there are problems, like global warming ability is still high, in recent years,

using a nature system refrigerant without such a problem is recommended. It is publicly known that supercritical refrigerants, such as carbon dioxide, are useful as this nature system refrigerant.

[0005]

[Problem(s) to be Solved by the Invention]And the refrigerating cycle of the refrigerant circuit which uses supercritical refrigerants, such as carbon dioxide, is shown in drawing 26. By the way, hot warm water (warm water) will flow into a circuit in the state where hot warm water has accumulated in the ************ case even at the lower part of the hot water reservoir tank. For this reason, the suicide-by-drowning temperature to the hydrothermal exchanger 75 will rise. When the suicide-by-drowning temperature to the hydrothermal exchanger 75 rose, it became a refrigerating cycle as shown as the solid line of drawing 28, the enthalpy difference in the condensation process became narrow, and hot-water-supply capability and COP were decreasing. Also when outdoor air temperature rose, the operating range was small as the refrigerating cycle was shown in drawing 29. That is, with various environment, the load change by the side of condensation and evaporation arises, and the refrigerant cycle stabilized by this load change is also changed. Therefore, the refrigerant amounts needed for each refrigerant cycle differed, respectively, even if filled up with the refrigerant according to a certain refrigerant cycle, the refrigerant cycle changed with operation conditions, with the refrigerant amount with which it was filled up, excess and deficiency arose and there was a possibility that it might become impossible to maintain a suitable refrigerant cycle.

[0006]Thus, in the refrigerating cycle used as a supercritical cycle, high voltage becomes continuous [the refrigerant density change in a supercritical region], and it can be said in the former that it is difficult to process the surplus refrigerant by which it is generated by operation area (difference in an operating condition). And if a surplus refrigerant cannot be processed, there is a possibility of becoming moisture operation. If it becomes moisture operation, the discharge temperature of the compressor 74 will fall, a refrigerating effect will decrease and COP will fall. If it is going to prevent this, design pressure must be made high and it will become a high cost.

[0007]Made in order that this invention may solve the above-mentioned conventional fault, that purpose of 1 is to provide the refrigerant circuit which can maintain a suitable refrigerating cycle in various kinds of operation conditions.

[0008]

[Means for Solving the Problem]Then, a refrigerant circuit of claim 1 is provided with the compressor 15, the condenser 16, the receiver 18, the expansion valve 19, and the evaporator 20, It is a refrigerant circuit using a supercritical refrigerant used for a refrigerant by supercritical, and is characterized by forming the cooling unit 17 which cools a refrigerant which flowed into the above-mentioned receiver's 18 upstream out of the above-mentioned

condenser 16.
[0009]In a refrigerant circuit of claim 1, since a refrigerant which flows into the receiver 18 by the cooling unit 17 can be cooled, when a load change by the side of condensation and evaporation arises with various environment etc., a refrigerant which was cooled enough and was high-density can be accumulated in the receiver 18. It can circulate that it is also at a suitable refrigerant amount by this through this refrigerant circuit.
[0010]A refrigerant circuit of claim 2 is characterized by operating some above-mentioned evaporators 20 as an air heat exchanger, and making this into the above-mentioned cooling unit 17.
[0011]In a refrigerant circuit of above-mentioned claim 2, since the cooling unit 17 is constituted from some evaporators 20, other heat exchangers are not needed separately but it becomes possible to attain the whole simplification.
[0012]A refrigerant circuit of claim 3 is characterized by the above-mentioned cooling unit 17 performing a refrigerant and heat exchange of an outlet side of the evaporator 20.
[0013]In a refrigerant circuit of above-mentioned claim 3, a refrigerant of an outlet side of the evaporator 20 is low temperature low pressure, and can cool certainly a refrigerant which goes into the receiver 18 with this refrigerant.
[0014]A refrigerant circuit of claim 4 is a refrigerant circuit using a supercritical refrigerant which is provided with the compressor 15, the condenser 16, the receiver 18, the expansion valve 19, and the evaporator 20, and is used for a refrigerant by supercritical, and is characterized by establishing the heat exchange means 30 which performs heat exchange of a high pressure refrigerant in the receiver 18, and a low pressure refrigerant.
[0015]In a refrigerant circuit of above-mentioned claim 4, a refrigerant in the receiver 18 can be certainly cooled with a low pressure refrigerant. Thereby, ****** of a refrigerant in the receiver 18 can be promoted and it can prevent that it will be in a surplus refrigerant state. A low pressure refrigerant is heated conversely and can prevent wet compression of the compressor 15.
[0016]A refrigerant circuit of claim 5 is characterized by the above-mentioned low pressure refrigerant being a refrigerant of an entrance side of the above-mentioned evaporator 20.
[0017]In a refrigerant circuit of above-mentioned claim 5, a refrigerant of an entrance side of the evaporator 20 is low temperature low pressure, and can cool a refrigerant in the receiver 18 certainly with this refrigerant.
[0018]A refrigerant circuit of claim 6 is characterized by the above-mentioned low pressure refrigerant being a refrigerant of an outlet side of the above-mentioned evaporator 20.
[0019]In a refrigerant circuit of above-mentioned claim 6, a refrigerant of an outlet side of the evaporator 20 is low temperature low pressure, and can cool a refrigerant in the receiver 18 certainly with this refrigerant.

[0020]The main path 54 for a high pressure refrigerant from the above-mentioned compressor 15 to pass the above-mentioned condenser 16, and for a refrigerant circuit of claim 7 flow into the above-mentioned expansion valve 19, The bypass circuit 55 for a high pressure refrigerant from the above-mentioned compressor 15 to flow into the receiver 18 is formed, and it is characterized by making a hot refrigerant flow into the receiver 18 rather than refrigerant temperature of an outlet side of the above-mentioned condenser 16.
[0021]In a refrigerant circuit of above-mentioned claim 7, a high pressure refrigerant which flows into the receiver 18 passes through the bypass circuit 55, and a hot refrigerant flows this receiver 18 rather than temperature of a refrigerant of condenser 16 outlet side. Thereby, large refrigerant temperature variation width in the receiver 18 can be taken, and a large refrigerant density difference of every operation area can be taken.
[0022]A refrigerant circuit of claim 8 is characterized by having extracted to the above-mentioned bypass circuit 55, and forming the mechanism S.
[0023]In a refrigerant circuit of above-mentioned claim 8, a refrigerant flow rate which passes through inside of the receiver 18 with the diaphragm mechanism S can be changed. A surplus refrigerant by which it is generated by the difference in an operating condition, etc. can be certainly accumulated in the receiver 18 by this, and surplus refrigerant absorptance can be raised.
[0024]A refrigerant circuit of claim 9 is provided with the compressor 15, the condenser 16, the receiver 18, the expansion valve 19, and the evaporator 20, It is a refrigerant circuit using a supercritical refrigerant used for a refrigerant by supercritical, and the bypass channel 55 for a high pressure refrigerant from the above-mentioned compressor 15 to flow into the receiver 18 is established, and it is characterized by performing heat exchange of a high pressure refrigerant in this receiver 18, and a low pressure refrigerant of an entrance side of the above-mentioned evaporator 20.
[0025]In a refrigerant circuit of above-mentioned claim 9, a refrigerant in the receiver 18 can be certainly cooled with a low pressure refrigerant. Thereby, ****** of a refrigerant in the receiver 18 can be promoted and it can prevent certainly that it will be in a surplus refrigerant state.
[0026]A refrigerant circuit of claim 10 is characterized by forming the flow control valve 56 in the above-mentioned receiver's 18 outlet side.
[0027]In a refrigerant circuit of above-mentioned claim 10, at the time of full admission of this flow control valve 56, refrigerant temperature can be raised and refrigerant capacity in the receiver 18 can be lessened. At the time of opening control of the flow control valve 56, it can hold to demanded refrigerant temperature and inside of the receiver 18 can be made into suitable refrigerant capacity. At the time of full close of the flow control valve 56, refrigerant temperature can be made low and refrigerant capacity in the receiver 18 can be increased.
[0028]

[Embodiment of the Invention]Next, the concrete embodiment of the refrigerant circuit of this invention is described in detail, referring to drawings. Drawing 1 shows the simplified schematic of the heat pump type hot water supply apparatus which uses this refrigerant circuit, and this heat pump type hot water supply apparatus is provided with the tank unit 1 and the heat source unit 2, and heats the water (warm water) of the tank unit 1 with the heat source unit 2.

[0029]The tank unit 1 is provided with the hot water reservoir tank 3, and the warm water by which hot water storing was carried out to this hot water reservoir tank 3 is supplied to the organ bath of a graphic display abbreviation, etc. Therefore, the water supply opening 5 is established in the bottom wall, the tapping hole 6 is formed in the upper wall, water is supplied to the hot water reservoir tank 3 from the water supply opening 5, and hot warm water carries out tapping to the hot water reservoir tank 3 from the tapping hole 6. In this case, the channel 8 for feed water which has the check valve 7 is connected to the water supply opening 5, the sluice gate 10 is established by the bottom wall of the hot water reservoir tank 3, and the hot water supply port 11 is established in the upper part of the side attachment wall (peripheral wall) of the hot water reservoir tank 3. And the sluice gate 10 and the hot water supply port 11 are connected in the circuit 12, and the pump 13 for water cycles and the heat exchanging path 14 are interposed in this circuit 12.

[0030]By the way, the four amount-of-residual-hot-water detectors 47a, 47b, 47c, and 47d are formed in a sliding direction with a predetermined pitch, and the temperature sensor 48 is further formed in the hot water reservoir tank 3 at the upper wall of the hot water reservoir tank 3. Each above-mentioned amount-of-residual-hot-water detectors 47a, 47b, 47c, and 47d and the temperature sensor 48 consist of thermo sensitive registers, respectively, for example. The intake thermo sensitive register 64 is formed in the above-mentioned circuit 12 at the upstream (specifically upstream of the pump 13) of the heat exchanging path 14, and the tapping thermo sensitive register 65 is formed in the downstream of the heat exchanging path 14.

[0031]The heat source unit 2 is provided with the refrigerant circuit R concerning this invention, and this refrigerant circuit R connects evaporator 20 grade with the compressor 15, the hydrothermal exchanger (condenser) 16 which constitutes the above-mentioned heat exchanging path 14, the cooling unit 17, the receiver 18, and the expansion valve 19 that constitutes reduced pressure control in order, and is constituted. And as a refrigerant of this refrigerant circuit R, the carbon dioxide (CO_2) used by supercritical is used, for example.

[0032]The above-mentioned cooling unit 17 cools the refrigerant which flowed out of the condenser 16, and comprises the liquid gas heat exchanger 21 shown in drawing 2. This liquid gas heat exchanger 21 is provided with the following.

The 1st passage 22 that is double pipe construction and through which the refrigerant from the condenser 16 passes.

The 2nd passage 23 through which the refrigerant from the evaporator 20 passes.
That is, the 1st passage 22 constitutes a part of refrigerant passage 24 which connects the condenser 16 and the receiver 18, and the 2nd passage 23 constitutes a part of refrigerant passage 25 which connects the evaporator 20 and the compressor 15. For this reason, this cooling unit 17 serves as a heat exchanger of a refrigerant-refrigerant, heat exchange is carried out between the refrigerant of the high voltage elevated temperature which passes through the 1st passage 22, and the refrigerant of the low-pressure low temperature which passes through the 2nd passage 23, and the refrigerant included in the receiver 18 is cooled. Since a low pressure refrigerant is heated, it can prevent the wet compression of the compressor 15.
[0033]By the way, this refrigerant circuit R connected the refrigerant passage 41 which connects the refrigerant passage 40 which connects the compressor 15 and the hydrothermal exchanger 16, and the expansion valve 19 and the evaporator 20 in the bypass circuit 42, and has formed the defrost valve 43 in this bypass circuit 42. HPS45 as a pressure protective switch and the pressure sensor 46 are formed in the above-mentioned refrigerant passage 40. This bypass circuit 42 is for performing defrosting operation which supplies the hot gas breathed out from the compressor 15 to the evaporator 20, and defrosts this evaporator 20. Therefore, this heat source unit 2 is equipped with the defrost control means (graphic display abbreviation) for performing a change with the usual water-heater operation and defrosting operation. That is, in the usual water-heater operation, the hydrothermal exchanger 16 functions as a condenser and the warm water which passes the heat exchanging path 14 is heated. When performing defrosting operation, the expansion valve 19 is changed into a full-close state, and hot gas is passed to the evaporator 20 by making the defrost valve 43 into an opened state, the evaporator 20 is heated with this hot gas, and the evaporator 20 is not made to generate frost. A defrost control means is constituted using a microcomputer, for example.
[0034]Next, operation operation (kettle operation) of the above-mentioned refrigerant circuit R is explained. The compressor 15 is made to drive and the pump 13 for water cycles is made to drive (operation). Then, stored water (warm water) flows out of the sluice gate 10 provided in the pars basilaris ossis occipitalis of the hot water reservoir tank 3, and this circulates the heat exchanging path 14 of the circuit 12. Then, this warm water is heated by the hydrothermal exchanger which is the condenser 16 (**********), and returns to the upper part of the hot water reservoir tank 3 from the hot water supply port 11. And by performing such operation continuously, hot water storing of the warm water will be carried out to the hot water reservoir tank 3. As for this operation, since the power-rates unit price at night is low set up compared with daytime as for the present power-rates system, it is preferred to carry out at the midnight time zone which is a small amount, and to aim at reduction of cost.
[0035]Thus, in the state where hot warm water has accumulated in the ************ case even

at the lower part of the hot water reservoir tank 3, the hot warm water in the hot water reservoir tank 3 will flow out of the sluice gate 10 into the circuit 12. In such a case, the suicide-by-drowning temperature of the hydrothermal exchanger 16 rises. In the conventional refrigerant circuit, if the suicide-by-drowning temperature of the hydrothermal exchanger 16 rises, as the refrigerating cycle shown in drawing 26 shows as the solid line of drawing 28, it will become a refrigerating cycle. For this reason, the refrigerant through which it circulates is excessive (surplus refrigerant state). However, in the refrigerant circuit R shown in drawing 1, since it has the cooling unit 17, a refrigerant is cooled enough and a high-density refrigerant collects in the receiver 18 in the high-tension side of the anteposition of the expansion valve 19. That is, surplus refrigerant processing can be performed, and the refrigerant amount which circulates through the refrigerant circuit R will become suitable, and will serve as a refrigerating cycle as shown in drawing 3. Therefore, stable operation is possible and the fall of COP is not caused. And it is possible to be able to set up small the capacity of the receiver which should provide and to aim at miniaturization of the whole refrigerant circuit and reduction of a manufacturing cost. Stable refrigerating operation can be performed.

[0036]Next, in the refrigerant circuit R shown in drawing 4, it has a channel which is constituted as the cooling unit 17 is also at the air heat exchanger 26, and constitutes a part of refrigerant passage 24 which connects the condenser 16 and the receiver 18, and when a refrigerant passes through this channel, air and heat exchange are performed. For this reason, the refrigerant amount which collects in the receiver 18 can be adjusted also with this cooling unit 17, and the refrigerant amount which circulates through the refrigerant circuit R will become suitable, and can perform stable refrigerating operation.

[0037]In the refrigerant circuit R of drawing 5, some evaporators 20 are operated as an air heat exchanger, and this is made into the cooling unit 17. That is, the evaporator 20 in this case is provided with the following.

The main part 27 which has many fins as shown in drawing 6.

The 1st-2nd tube 28 and 29 allocated in this main part 27.

And the refrigerant from the expansion valve 19 is passed for the inside of the 1st tube 28, and the refrigerant from the condenser 16 is passed for the inside of the 2nd tube 29. For this reason, an original evaporation function is exhibited as the main part 27 and 1st tube 28 grade are also, and the function as the main part 27 and the cooling unit (air heat exchanger) 17 which cools the refrigerant which flowed that 2nd tube 29 grade was also out of the condenser 16 is exhibited. In this case, the 1st tube 28 is made into meandering state, and those double door regio oralis 28a and 28b is carrying out the opening to one side 27a side of the main part 27. The 2nd tube 29 is made into the shape of a U character, and the double door regio oralis 29a and 29b is carrying out the opening to the one side face 27a side of the main part 27. In this way, as what constitutes the cooling unit 17, some evaporators 20 do not restrict to what is

shown in this drawing 6, and, also as for change of the size of the main part 27, the linear dimension of the 1st-2nd tube 28 and 29, etc., it is free, for example.
[0038]For this reason, the refrigerant circuit R of drawing 5 can process the surplus refrigerant by which it is generated by environmental variations, such as a suicide-by-drowning temperature (suicide-by-drowning temperature to hydrothermal exchanger 16) rise, like above-mentioned drawing 1 etc., the refrigerant amount which circulates through the refrigerant circuit R will become suitable, and stable refrigerating operation can be performed. And the cooling unit 17 can be constituted with some evaporators 20 which do not need heat exchanger 26 grade as shown in the heat exchanger 21 as shown in drawing 1, or drawing 4, but are naturally needed for this kind of refrigerant circuit, and miniaturization of the whole refrigerant circuit R and reduction of a manufacturing cost can be aimed at.
[0039]Next, the receiver 18 which shows drawing 15 is used, and it constitutes from the refrigerant circuit R shown in drawing 7 so that heat exchange of the high pressure refrigerant in the receiver 18 and a low pressure refrigerant may be performed. That is, the inhalant canal 50 into which the refrigerant from the condenser 16 flows, and the excurrent canal 51 in which the refrigerant from the receiver 18 flows into the expansion valve 19 are connected, respectively, and the refrigerant passage 41 which connects the expansion valve 19 and the evaporator 20 is inserted in the receiver 18 in this case. Thereby, the heat exchange means 30 which performs heat exchange between the high pressure refrigerant which flows into the receiver 18, and the low pressure refrigerant which flows through the refrigerant passage 41 comprises the inhalant canal 50.
[0040]According to the refrigerant circuit R of this drawing 7, since the refrigerant of the low-tension side for performing heat exchange is a refrigerant of the entrance side of the evaporator 20, it can perform heat exchange certainly and can promote ****** of the refrigerant in the receiver 18. For this reason, the refrigerant amount which circulates through the refrigerant circuit R under the condition which a surplus refrigerant generates does not cause the fall of COP, without becoming suitable quantity and becoming moisture operation.
[0041]In the refrigerant circuit R shown in drawing 8, the refrigerant passage (suction passage) 25 which connects the evaporator 20 and the compressor 15 is inserted in the receiver 18. It can prevent that the heat exchange means 30 which performs heat exchange of the receiver's 18 high pressure refrigerant and the low pressure refrigerant which circulates the refrigerant passage 25 can be constituted, ****** of the refrigerant in the receiver 18 can be promoted, and it will be in a surplus refrigerant state by this.
[0042]Next, the refrigerant circuit R shown in drawing 9 is provided with the following.
The main path 54 where the refrigerant from the compressor 15 flows into the expansion valve 19 via the condenser 16 and the heat exchanger 49.
The bypass circuit 55 which a refrigerant shunts from the main path 54 and joins the main path

54 via the receiver 18.
That is, the main path 54 is provided with the following.
Refrigerant passage 40 (refrigerant discharge passage of the compressor 15).
the 1st which it has the communication trunk 57 connected to the expansion valve 19 via the heat exchanger (heat exchanger for giving supercooling to the refrigerant which flows out of the condenser 16) 49 from the condenser 16, and the bypass circuit 55 branches from the refrigerant discharge passage 40, and is connected to the receiver 18 -- pipe 58.
the 2nd connected to the main path 54 from the receiver 18 -- pipe 59.
The heat exchanger 49 performs heat exchange of the refrigerant which flows through the communication trunk 57, and the refrigerant which flows through the refrigerant passage 25.
[0043]According to this refrigerant circuit R, in the main path 54, the high pressure refrigerant from the compressor 15 flows with the condenser 16 -> heat exchanger 49 -> expansion valve 19 -> evaporator 20 -> receiver 18 -> heat exchanger 49 -> compressor 15. For this reason, the warm water which circulates through the circuit 12 (in this case, the graphic display abbreviation is carried out) with the condenser 16 as a hydrothermal exchanger can be heated. In the bypass circuit 55, the high pressure refrigerant from the compressor 15 flows into the receiver 18, it flows into the expansion valve 19 from the receiver 18, and the refrigerant which flowed out of the evaporator 20 returns to the compressor 15 via the refrigerant passage 25 further. For this reason, the 1st pipe of the heat exchange means 30 which performs heat exchange between the high pressure refrigerant which flowed into the receiver 18, and the low pressure refrigerant which flows through the refrigerant passage 25 can consist of 58.
[0044]Next, the refrigerant circuit R shown in drawing 10 connects the 1st pipe of the condenser 16 and the receiver 18 in 58, and the refrigerant circuit R shown in drawing 11 connects the 1st pipe of the exit and the receiver 18 of the condenser 16 in 58. Also in these, heat exchange of the high pressure refrigerant in the receiver 18 and the low pressure refrigerant which circulates the refrigerant passage 25 can be performed.
[0045]The refrigerant circuit R of the refrigerant circuit R which the refrigerant circuit R shown in drawing 12 shows to drawing 10 which extracts the 1st pipe to 58, interposes the mechanism S (for example, capillary tube), and is shown in drawing 13. the refrigerant circuit R shown in drawing 10 -- the 2nd pipe is extracted to 59 and the mechanism S (for example, capillary tube) is interposed. The refrigerant flow rate which passes through the inside of the receiver 18 in these cases can be changed. That is, the surplus refrigerant by which it is generated by the difference in an operating condition can be certainly accumulated in the receiver 18, and surplus refrigerant absorptance can be raised. In the refrigerant circuit R shown in drawing 14, it extracts, the mechanism S is replaced with a capillary tube, it constitutes from an electric motor operated valve, and the same operation effect as the refrigerant circuit R shown in drawing 13 is presented. For this reason, also in the refrigerant

circuit R shown in drawing 12, it may replace with a capillary tube and an electric motor operated valve may be used. Also in the refrigerant circuit R shown in drawing 9 and drawing 11, it may extract to the bypass circuit 55 and the mechanism S may be formed.

[0046]By the way, in the refrigerant circuit R of drawing 7 and drawing 8, the refrigerant state in the receiver 18 is decided by the exit state of the hydrothermal exchanger (condenser) 16. Therefore, the receiver's 18 surplus refrigerant absorptance serves as x (refrigerant density of hydrothermal exchanger 16 exit) capacity. For this reason, in these, it does not become not much big absorptance. On the other hand, in the refrigerant circuit R (the refrigerant circuit R shown in drawing 11 is excluded) shown in drawing 13 from drawing 9, the refrigerant (refrigerant of a temperature higher than outlet temperature) of the temperature which is different from the outlet temperature of the hydrothermal exchanger (condenser) 16 can be accumulated in the receiver 18. For this reason, the large refrigerant density difference of every operation area can be taken, and surplus refrigerant absorptance becomes large. In this case, the refrigerant circuit R shown in drawing 9 shows the biggest surplus refrigerant absorptance. The refrigerant circuit R which this shows to this drawing 9 is because the refrigerant temperature variation width in the receiver 18 is the largest. When heat loss (quantity which radiates heat by a hydrothermal exchanger in addition to water) is compared about the refrigerant circuit R of drawing 11 from drawing 9, the refrigerant circuit R shown in drawing 9 is the largest, the refrigerant circuit R which drawing 10 shows is smaller than it, and the refrigerant circuit R shown in drawing 11 becomes the smallest. This is because 58 [pipe / 1st] has branched from the outlet side of the condenser 16 in the refrigerant circuit R shown in drawing 11.

[0047]As the receiver 18 in the refrigerant circuit R shown in drawing 7 - drawing 14, it may be shown in drawing 16. In this case, the refrigerant passage 41 or the refrigerant passage 25 is made to meet the receiver's 18 outside surface, and, thereby, heat exchange of the high pressure refrigerant in the receiver 18 and the low pressure refrigerant which circulates the refrigerant passage 41 (or refrigerant passage 25) can be performed. When making the refrigerant passage 41 or the refrigerant passage 25 meet, linear shape may be made to allocate in the shape of parallel, or it may be made to wind on the receiver's 18 peripheral face, as shown in this drawing 16.

[0048]an imaginary line shows the refrigerant circuit R shown in drawing 9 - drawing 14, respectively -- as -- the bypass circuit 55 -- while connecting 58 [pipe / 1st] to the upstream part of the hydrothermal exchanger 16 -- the bypass circuit 55 -- it may be made to connect 59 [pipe / 2nd] to the pars intermedia of the hydrothermal exchanger 16 By connecting in this way, it becomes possible to attain reduction of heat loss, and optimization of a rise the receiver's 18 inlet refrigerant temperatures. In this case, the main path 54 is a channel shown as the solid line of these drawing 9 - drawing 14. Such arrangement order may be made to

become an example of a figure, and an inverse ramp by the thing provided with the receiver 18 and the heat exchanger (liquid gas heat exchanger) 49 like the refrigerant circuit R shown in drawing 9 - drawing 14.

[0049]By the way, as shown in drawing 17, establish the bypass channel 55 which branches from the condenser 16 and joins this condenser 16 in the position of the downstream rather than this tee, and. The receiver 18 may be interposed in this bypass channel 55, and heat exchange of the high pressure refrigerant in this receiver 18 and the low pressure refrigerant of the entrance side of the evaporator 20 may be performed. That is, the main path 54 for the high pressure refrigerant from the compressor 15 to pass the condenser 16, and flow into the above-mentioned expansion valve 19 has the refrigerant discharge passage 40 and the communication trunk 57, and the bypass circuit 55 is connected to this main path 54. concrete -- the bypass circuit 55 -- the -- while 58 [pipe / 1st] is connected to mist or upper slippage from the pars intermedia of the condenser 16 -- the -- 59 [pipe / 2nd] is connected to mist or downstream slippage from the pars intermedia of the condenser 16 -- this -- the receiver 18 is interposed in 59 in between the 2nd pipe with 58 the 1st pipe. For this reason, the high pressure refrigerant which branched from the main path 55 will pass the receiver 18, and will join the main path 55 (flowing back). The refrigerant of the main path 54 will flow into the expansion valve 19 by flowing through the communication trunk 57 also in this case via the heat exchanger (heat exchanger for giving supercooling to the refrigerant which flows out of the condenser 16) 49.

[0050]And as shown in drawing 18 and drawing 19, the receiver 18 is installed in the refrigerant passage (low pressure pipes) 41 which connects the expansion valve 19 and the evaporator 20 side by side so that heat exchange is possible. namely, the projected part 41a which the part which extends along with the receiver 18 among the refrigerant passages 41 is formed in what is called zigzag shape, and approaches thru/or contacts to the receiver 18 .. is connected to the receiver's 18 outer wall 18a in connecting means, such as low attachment. Heat exchange is performed by this with the high pressure refrigerant which passes through the inside of the receiver 18, and the low pressure refrigerant which flows through the refrigerant passage 41. Under the present circumstances, in order to distribute the contacted part with the receiver 18 of the refrigerant passage 41, local heat exchange is prevented and overall heat exchange is performed. Of course, without providing a zigzag part in the refrigerant passage 41, the receiver's 18 outer wall 18a is made to meet as [linear shape], and the contiguity thru/or contact may be connected in connecting means, such as low attachment.

[0051]As shown in drawing 17, the flow control valve 56 which connects the receiver 18 and the condenser 16 and which changes from an electric motor operated valve to 59 the 2nd pipe is interposed. That is, this flow control valve 56 is formed in the receiver's 18 outlet side. For

this reason, at the time of full admission of this flow control valve 56. Can raise refrigerant temperature, can lessen refrigerant capacity in the receiver 18, and at the time of the opening control of the flow control valve 56. It can hold to the demanded refrigerant temperature and the inside of the receiver 18 can be made into suitable refrigerant capacity, at the time of full close of the flow control valve 56, refrigerant temperature can be made low and refrigerant capacity in the receiver 18 can be increased. By this, it is stabilized and the surplus refrigerant by which it is generated in the difference in an operating condition, etc. can be processed certainly.

[0052]In the refrigerant circuit of this drawing 17, it has the piping 42 for defrost (bypass circuit) in which the defrost valve 43 was interposed. That is, the piping 42 for defrost which branched from the refrigerant discharge passage 40 is connected to the refrigerant passage 41 in the entrance side of the evaporator 20. By this, heat loss can be prevented to a defrosting period.

[0053]Thus, also in the refrigerant circuit of drawing 17, ****** of the refrigerant in the receiver 18 can be promoted and it can prevent that it will be in a surplus refrigerant state. Also in the refrigerant circuit of this drawing 17, as drawing 9 - the solid line of drawing 14, and an imaginary line show, repositioning of the tee of the bypass circuit 55 or a merging section is free. for example, the bypass circuit 55 -- while connecting 58 [pipe / 1st] to the upstream part of the condenser 16 -- the bypass circuit 55 -- it may be made to connect 59 [pipe / 2nd] to the downstream of the condenser 16, and what is necessary is just to make it the 1st pipe of a height pressure deficit [2nd pipe of] arise between 59 with 58 in the anteposition of the expansion valve 19 in short

[0054]By the way, in the refrigerant circuit R, in order to prevent the liquid back (liquid return) to the compressor 15, a fluid separation machine (accumulator) may be formed. However, it became a high cost by forming an accumulator, and inlet-pressure loss of the compressor 15 increased, COP fell, and there was a problem of an allophone occurring in an accumulator further.

[0055]Therefore, as shown in drawing 20, it is preferred to form the heating method 33 for liquid return prevention in the refrigerant suction path 32 (it is a channel from the cooling unit 17 to the compressor 15 among the refrigerant passages 25) of the compressor 15. In this case, the heating method 33 is provided with the following.

It is the bobbin 34, as it is an electromagnetic-induction-heating machine and is shown in drawing 21.

The electromagnetic-induction-heating heater (coil) 35 wound on this bobbin 34.

That is, the bobbin 34 consists of the cylinder part 34a and the outside flange parts 34b and 34b formed successively by the both ends of this cylinder part 34a, and the electromagnetic-induction-heating heater 35 is wound on the cylinder part 34a. And inner fitting of the wrap thermal insulation 37 is carried out to the cylinder part 34a in the iron pipe 36 and this iron pipe

36, and the thermal insulation 38 is attached outside by the electromagnetic-induction-heating heater 35. And the iron pipe 36 constitutes a part of above-mentioned refrigerant suction path 32. If it has a power supply of the graphic display abbreviation which sends current through the electromagnetic-induction-heating heater 35 in this heating method 33 and current is sent through the electromagnetic-induction-heating heater 35 from this power supply, a countless eddy current occurs in the iron pipe 36, the iron pipe 36 will be heated by this and the refrigerant which flows through this iron pipe 36 will be heated.

[0056]The control section of this refrigerant circuit R is provided with the control means of the graphic display abbreviation which controls the heating method 33. Namely, as shown in drawing 20, near the delivery of the refrigerant discharge passage 40 near the suction opening of the refrigerant suction path 32, The thermo sensitive registers 60 and 61 are formed, respectively, and in the evaporator 20, the thermo sensitive register 62 for evaporators is formed, and it is judged to it whether the liquid back to the compressor 15 occurs based on this thermo sensitive register 62 for evaporators, and the thermo sensitive register 60 of the refrigerant suction path 32. And when there is a possibility that a liquid back may occur, current is sent through the heating method 33 and the refrigerant of the refrigerant suction path 32 is heated. In drawing 20, 63 is a thermo sensitive register for the open air. Although the graphic display abbreviation is carried out, also in the refrigerant circuits R, such as above-mentioned drawing 1, these thermo sensitive registers 60, 61, 62, and 63 are formed.

[0057]That is, during defrosting operation, the above-mentioned heating method 33 is operated by the above-mentioned control means to the transients at the time of a defrost return, etc., the refrigerant of the refrigerant suction path 32 is heated to them, and the liquid return (liquid back) to the compressor 15 is prevented by this to them in the refrigerant circuit shown in this drawing 20. Thus, if the heating method 33 is established, without forming an accumulator, a liquid back can be prevented and can aim at reduction of cost, and. The fall of COP by inlet-pressure loss can be prevented, further, the cause of allophone generating can be removed and quiet operation is attained. Since the electromagnetic-induction-heating machine is used for the heating method 33 in this case, it is clean and safe and thermal efficiency also has a high advantage. By the way, in this refrigerant circuit R, if full close or below the degree of predetermined open angle carries out the expansion valve 19 which is an electric motor operated valve between predetermined time from starting of the compressor 15, the rapid liquid return to the compressor 15 of the refrigerant which exists in the thick line part (high pressure part) of drawing 22 can be prevented.

[0058]In the refrigerant circuit R of drawing 23, the regulating valve (electric motor operated valve) 66 for flow control is interposed in the upstream rather than the heating method 33 in the refrigerant suction path 32. Namely, in this refrigerant circuit R, extract a flow by extracting this regulating valve 66 to the transients at the time of a defrost return, etc. during defrosting

operation at the time of a defrost start up at the time of operation starting, and. Heating by the heating method 33 can be performed, liquid return can be prevented, and more positive liquid back prevention can be attained.

[0059]Next, the refrigerant circuit R shown in drawing 24 forms the liquid return preventive valve 67 which consists of electromagnetic valves, for example between the compressor 15 and the condenser 16. In this case, full close or below the degree of predetermined open angle carries out the expansion valve 19 which is an electric motor operated valve between predetermined time from starting of the compressor 15 at the time of defrosting operation, and. By making the liquid return preventive valve (electromagnetic valve) 67 into a closed state, the rapid liquid return to the compressor 15 of the refrigerant which exists in a thick line part (high pressure part) (range from the liquid return preventive valve 67 to the expansion valve 9) can be prevented. Also in the refrigerant circuit R of this drawing 24, since the heating method 33 is formed in the refrigerant suction path 32, at the time of operation starting and a defrost start up, etc., the refrigerant of the refrigerant suction path 32 can be heated by the heating method 33, and the liquid back to the compressor 15 can be prevented. Also in the refrigerant circuit R shown in this drawing 24, like the refrigerant circuit R of drawing 23, the regulating valve 66 is formed in the refrigerant suction path 32, and, in addition to heating by the heating method 33, it may be made to extract the flow by this regulating valve 66.

[0060]Next, without establishing the heating method 33, the refrigerant circuit R shown in drawing 25 forms the liquid return preventive valves 68 and 69 in the refrigerant suction path 32 and the refrigerant discharge passage 40 of the compressor 15, respectively, and prevents the liquid back to the compressor 15 after shutdown by these liquid return preventive valves 68 and 69. That is, after shutdown, it prevents flowing into the compressor 15 from the refrigerant suction path 32 and the refrigerant discharge passage 40 by making both the liquid return preventive valves 68 and 69 into a closed state, and breakage of the compressor 15 by poor starting and liquid compression at the time of starting of the next compressor 15 is prevented. The heating method 33 is formed in the refrigerant suction path 32, and a refrigerant is heated by this heating method 33 to the transients at the time of a defrost return, etc., and it may be made to prevent the liquid back to the compressor 15 to them during defrosting operation also in the refrigerant circuit R of this drawing 25 at the time of a defrost start up at the time of operation starting.

[0061]By the way, as the heating method 33 used in above-mentioned drawing 20 etc., it may constitute from heater wires which consist of Nichrome wires etc. in addition to an electromagnetic-induction-heating machine. It is also preferred by performing open-phase preheating operation of the inverter circuit of this compressor 15, by the time it carries out specified time elapse after powering on of the compressor 15 besides the above-mentioned liquid back prevention operation to make it evaporate the refrigerant in the compressor 15.

[0062]Although the concrete embodiment of this invention was described above, this invention is not limited to the above-mentioned gestalt, within the limits of this invention, can be changed variously and can be carried out. For example, it may be possible to use it for refrigerant circuits other than a heat pump type hot water supply apparatus, and it may be a refrigerant used by supercritical [, such as ethylene, ethane, nitrogen oxide,] in addition to carbon dioxide as a refrigerant. In this invention, the condenser 16 has a function which cools the hot and high-pressure supercritical refrigerant compressed with the compressor 15, and may be called a syngas cooler (radiator).

[0063]

[Effect of the Invention]According to the refrigerant circuit of claim 1, also when the load change by the side of condensation and evaporation arises, the refrigerant amount which circulates through a refrigerant circuit is maintainable in a suitable quantity, stable operation is possible and the fall of COP is not caused. And it is possible to be able to set up small the capacity of the receiver which should provide and to aim at miniaturization of the whole refrigerant circuit and reduction of a manufacturing cost.

[0064]According to the refrigerant circuit of claim 2, other heat exchangers are not needed separately, but it becomes possible to attain the whole simplification, and reduction of a manufacturing cost can be aimed at further.

[0065]According to the refrigerant circuit of claim 3, the refrigerant included in a receiver can be cooled certainly. By this, a suitable refrigerating cycle is certainly maintainable.

[0066]According to the refrigerant circuit of claim 4, under the condition which a surplus refrigerant generates, it can circulate through this refrigerant circuit with a suitable refrigerant amount in the conventional refrigerant circuit. That is, the surplus refrigerant by which it is generated in the difference in an operating condition can be processed, and improvement in COP and reduction of cost are attained. Since the refrigerant of the low-tension side is heated conversely and the wet compression of a compressor can be prevented, the reliability of a compressor improves.

[0067]According to the refrigerant circuit of claim 5 or claim 6, a surplus refrigerant can be processed much more certainly and improvement in COP and reduction of cost are attained.

[0068]According to the refrigerant circuit of claim 7, the large refrigerant ****** difference of every operation area can be taken. By this, surplus refrigerant absorptance can become large, reduction in a refrigerating effect can be prevented certainly, and improvement in COP can be aimed at. [0069]According to the refrigerant circuit of claim 8, improvement in surplus refrigerant absorptance can be aimed at certainly, and improvement in the reliability as a refrigerant circuit can be aimed at. [0070]According to the refrigerant circuit of claim 9, under the condition which a surplus refrigerant generates, it can circulate through this refrigerant circuit with a suitable refrigerant amount in the conventional refrigerant circuit. That is, the

surplus refrigerant by which it is generated in the difference in an operating condition can be processed, and improvement in COP and reduction of cost are attained.
[0071]According to claim 10 refrigerant circuit, it is stabilized and the surplus refrigerant by which it is generated in the difference in an operating condition can be processed certainly.

[Translation done.]

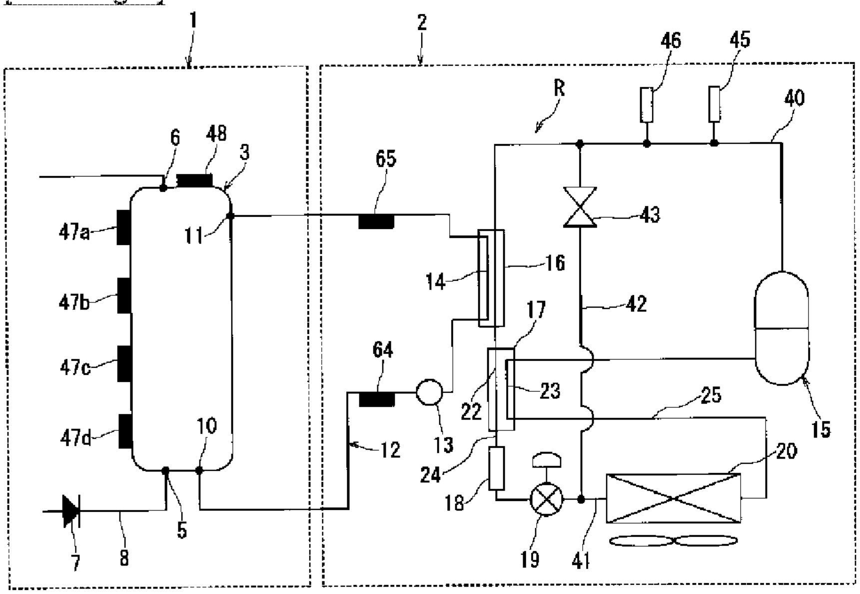
* NOTICES *

JPO and INPIT are not responsible for any damages caused by the use of this translation.

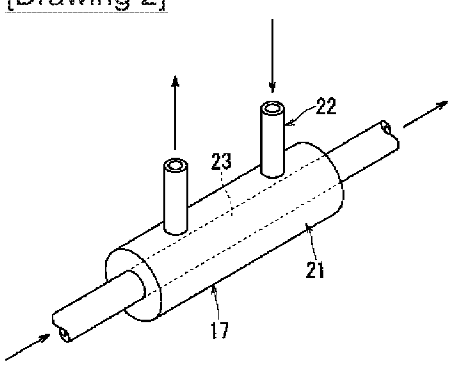
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

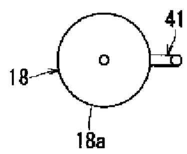
[Drawing 1]



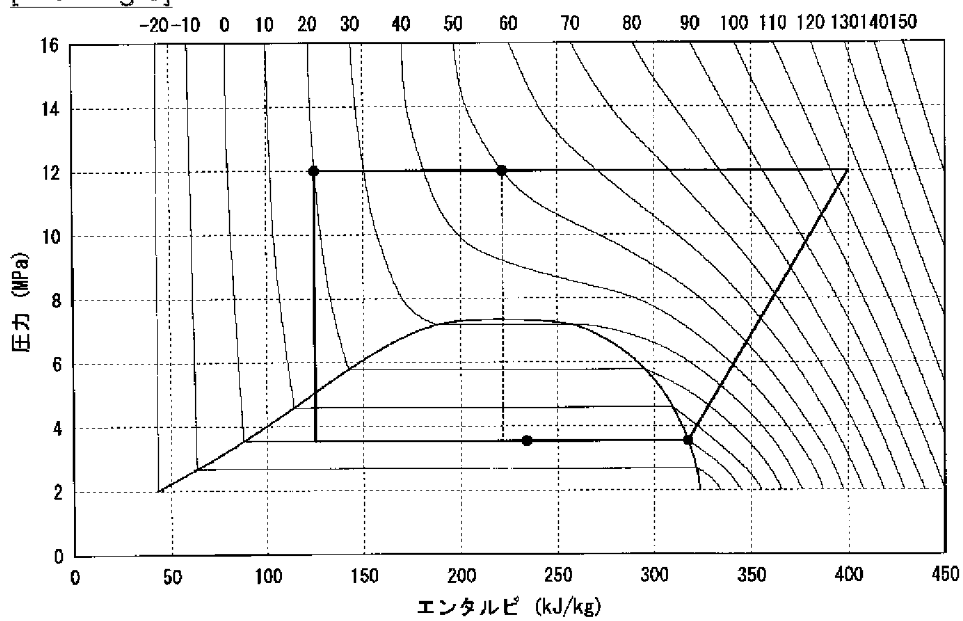
[Drawing 2]



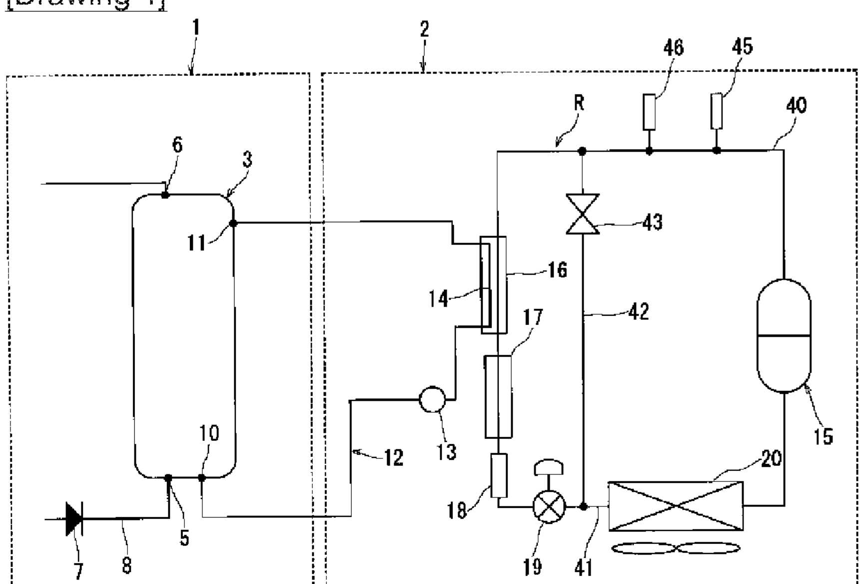
[Drawing 19]



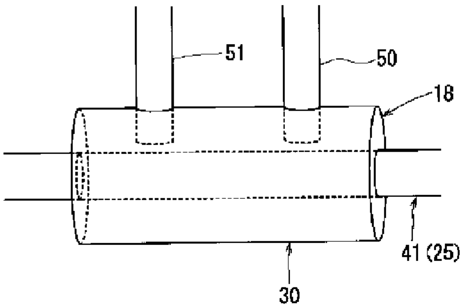
[Drawing 3]



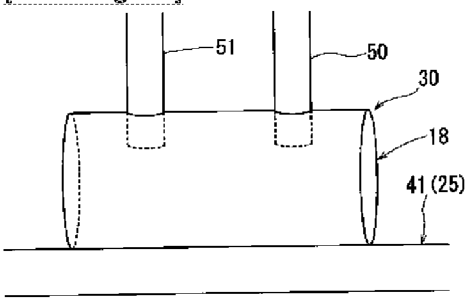
[Drawing 4]



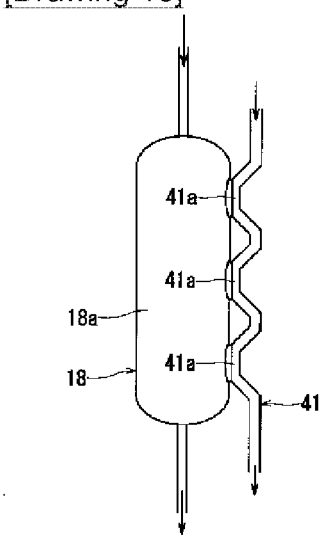
[Drawing 15]



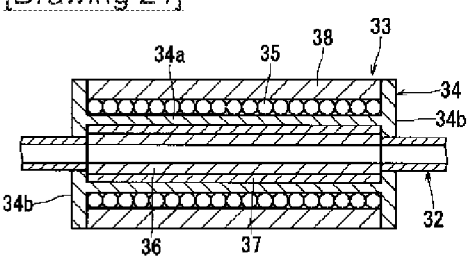
[Drawing 16]



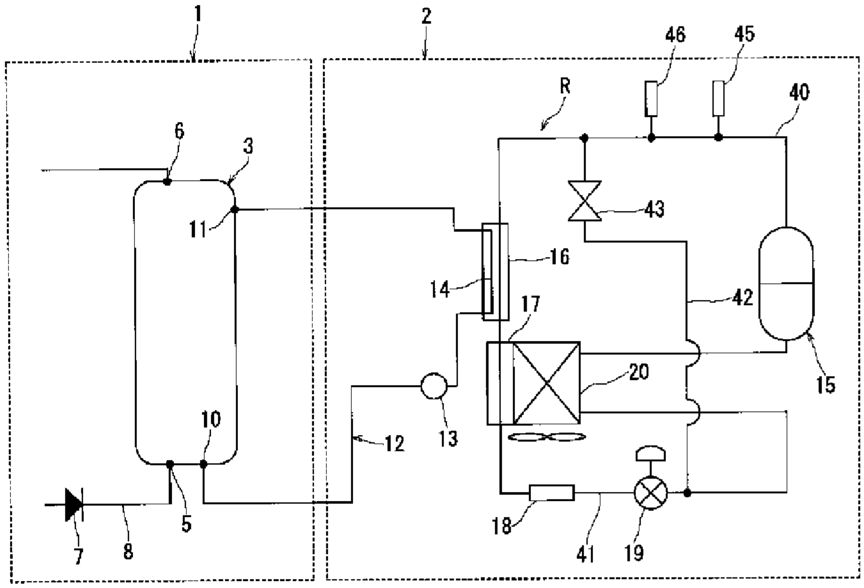
[Drawing 18]



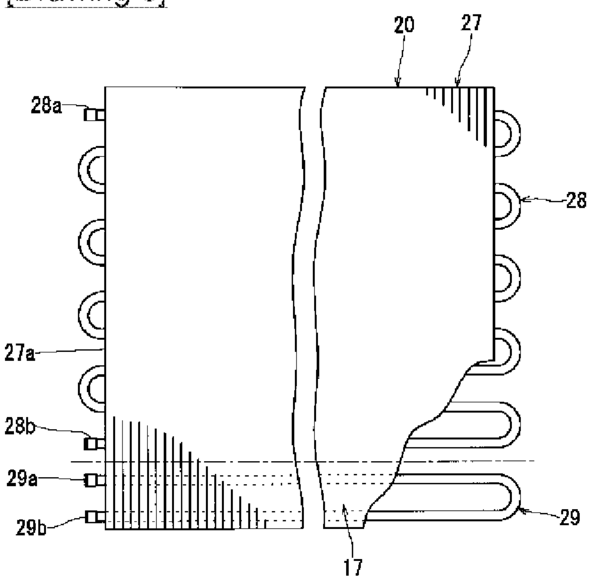
[Drawing 21]



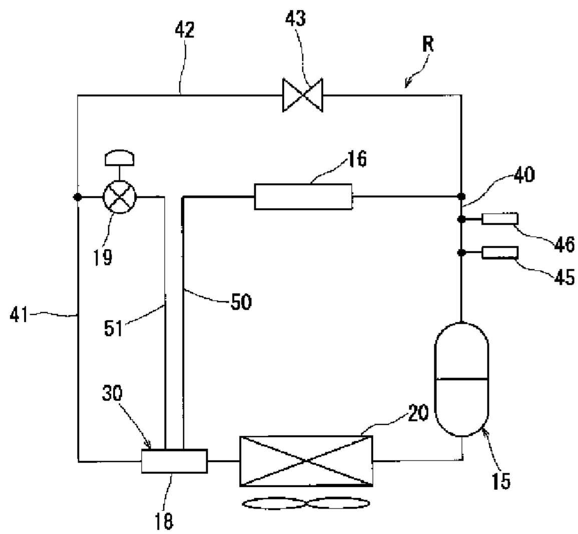
[Drawing 5]



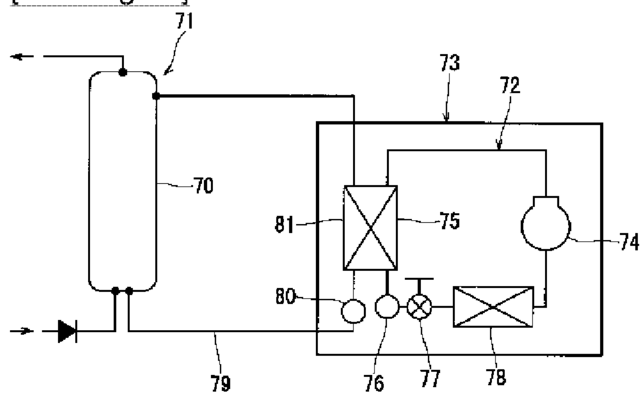
[Drawing 6]



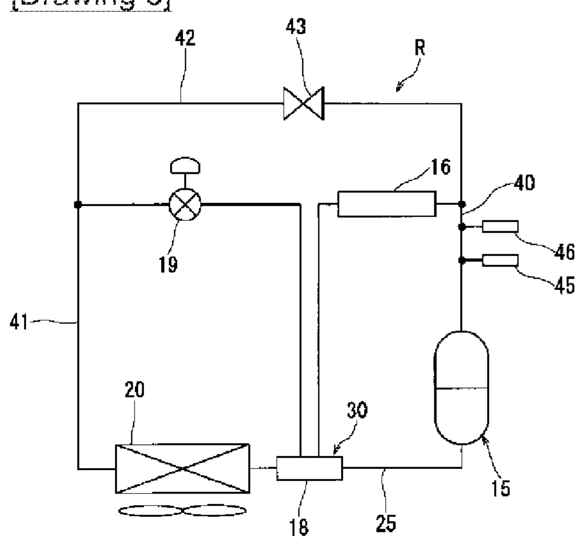
[Drawing 7]



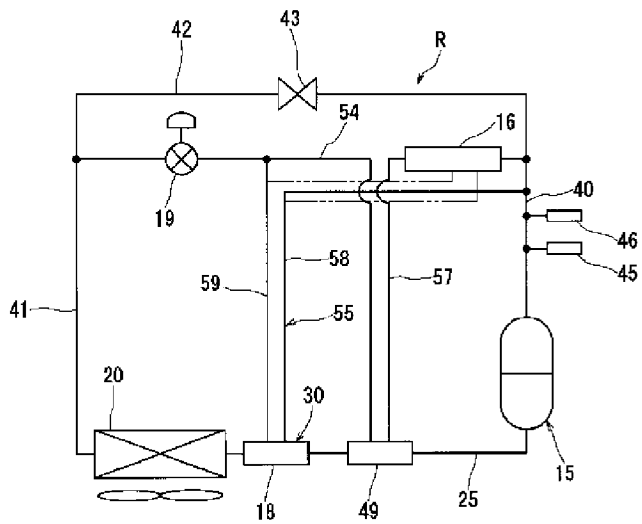
[Drawing 27]



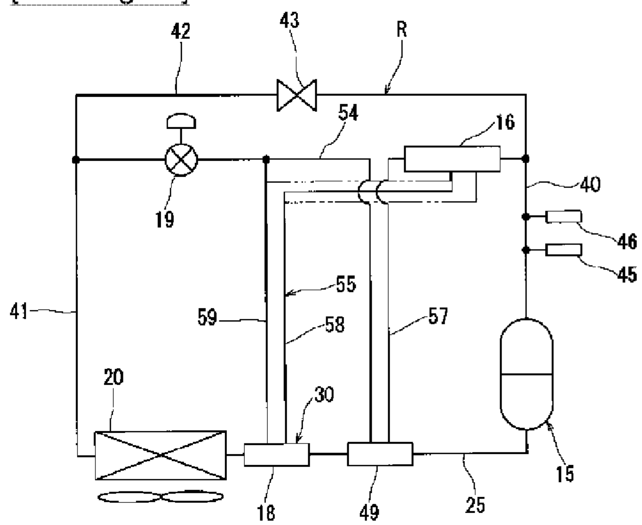
[Drawing 8]



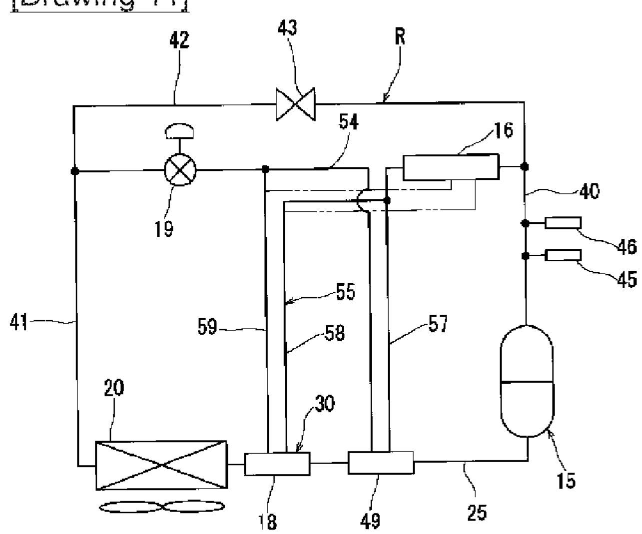
[Drawing 9]



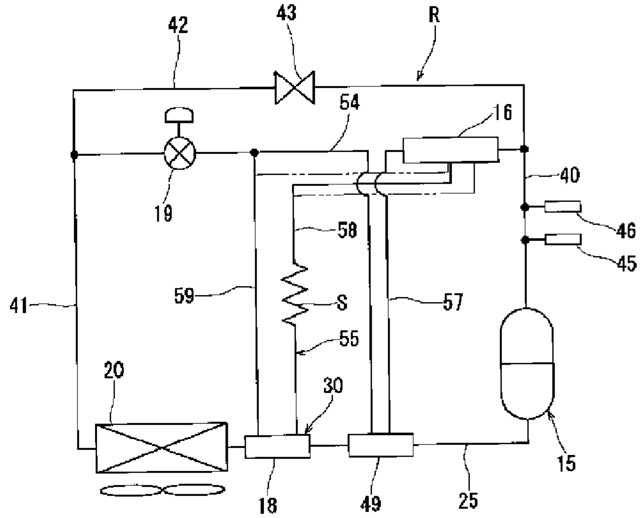
[Drawing 10]



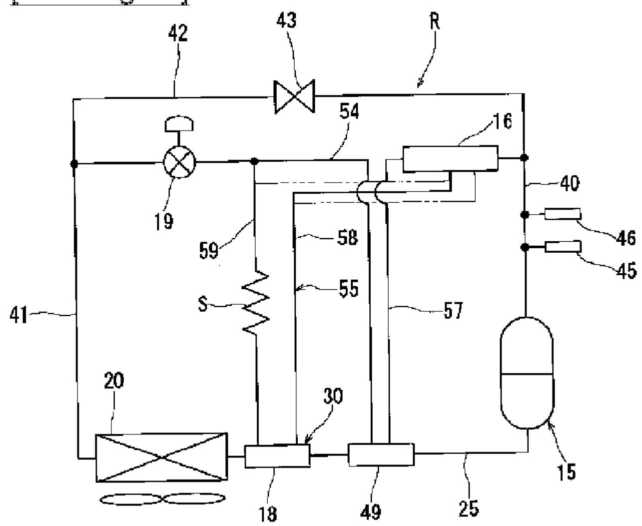
[Drawing 11]



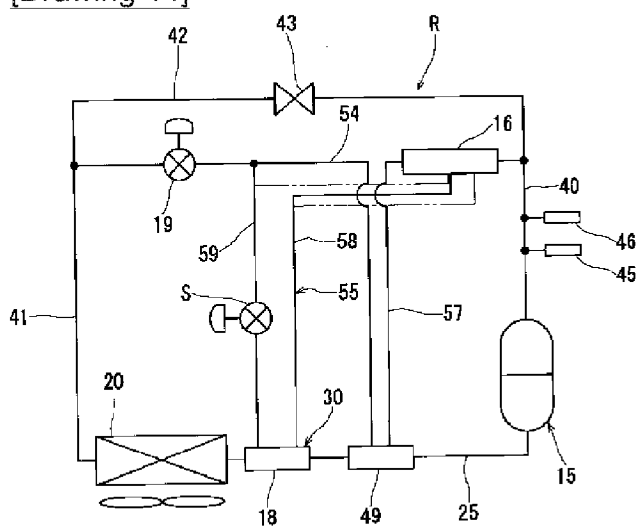
[Drawing 12]



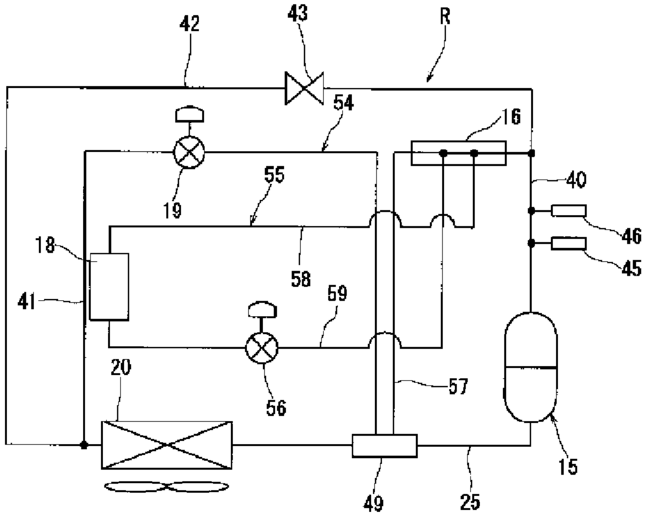
[Drawing 13]



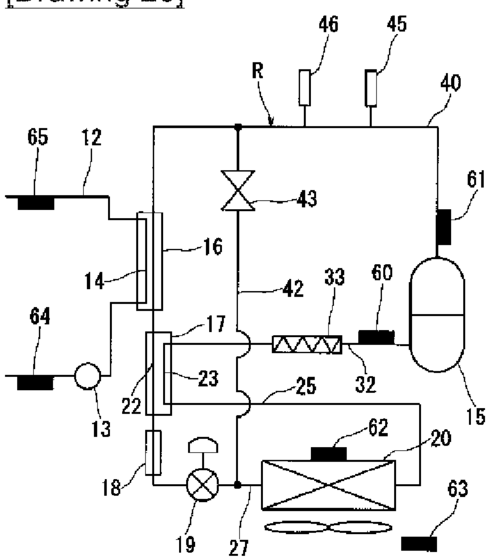
[Drawing 14]



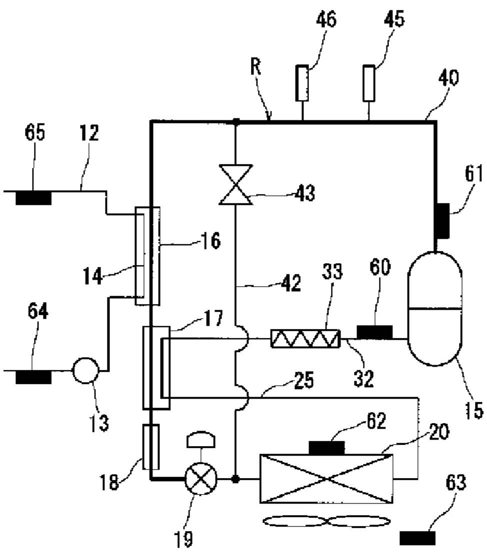
[Drawing 17]



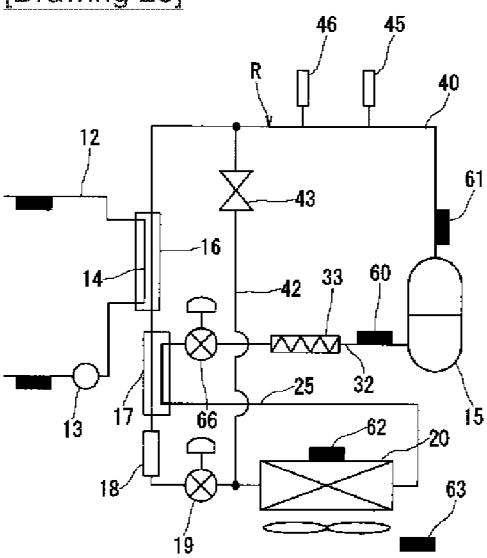
[Drawing 20]



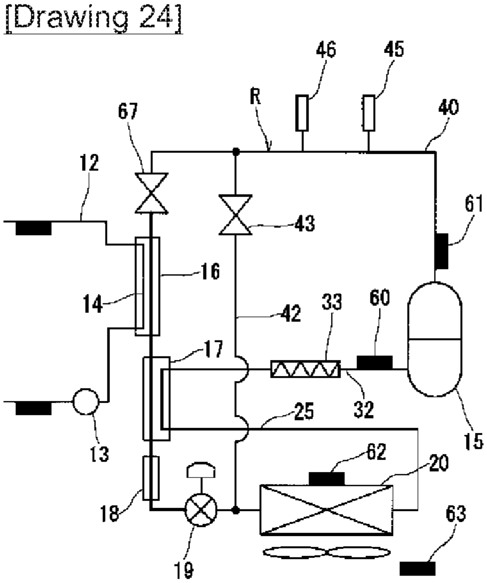
[Drawing 22]



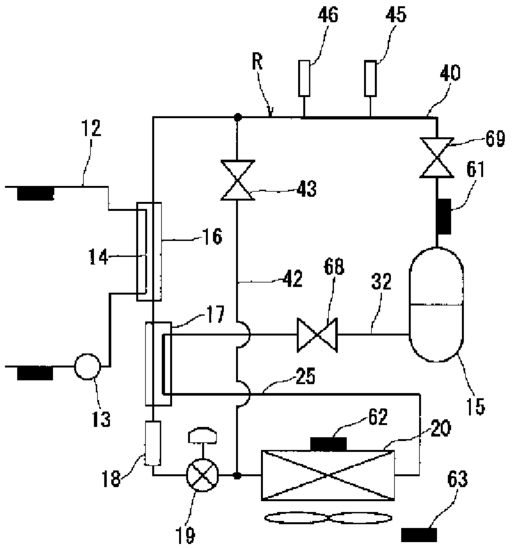
[Drawing 23]



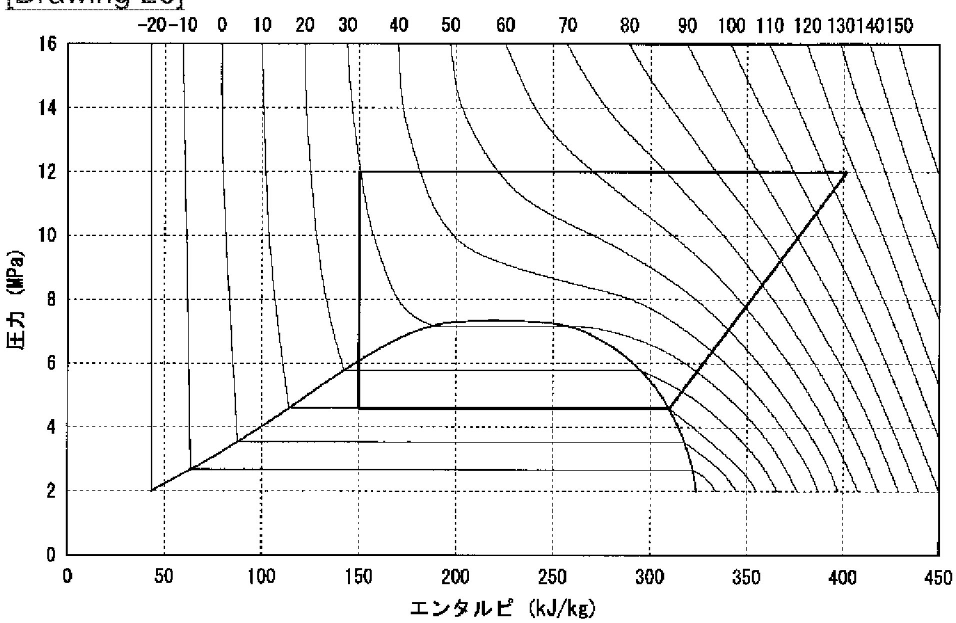
[Drawing 24]



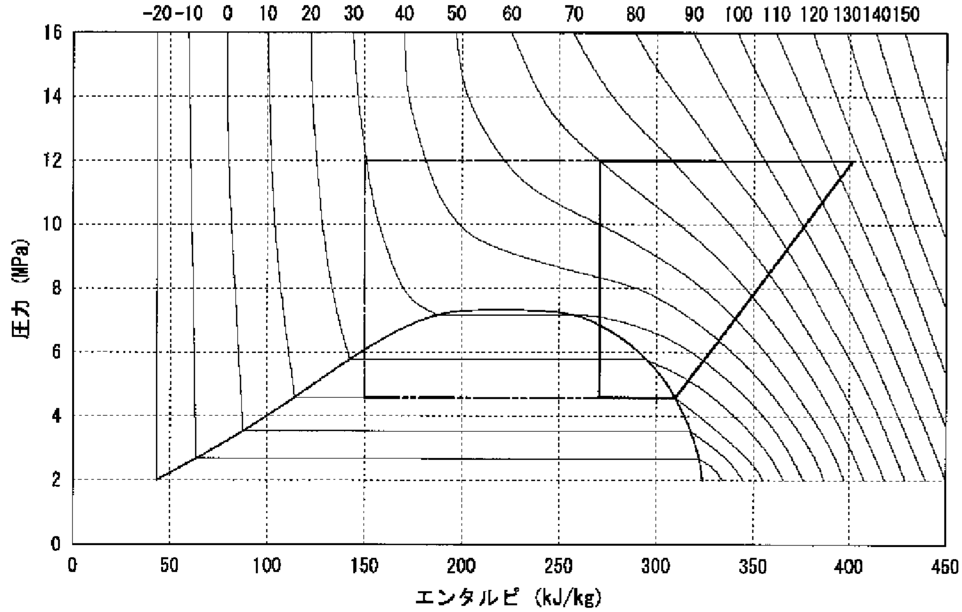
[Drawing 25]



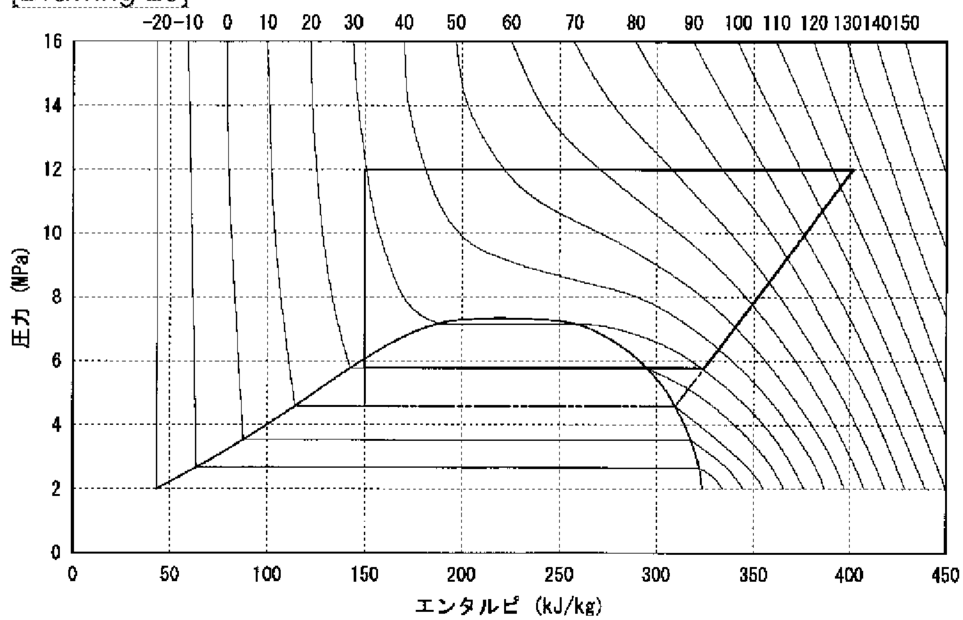
[Drawing 26]



[Drawing 28]



[Drawing 29]



[Translation done.]